Title: The Information

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Abstract: In this work, based on the analysis of speech models, the basic properties of information are determined, which are subsequently extended to the construction of a theory of Information. The Information model itself can be applied not only to the humanities, but also to the natural sciences.

One Sentence Summary: A New Approach to the Concept of Information

Information.

What is information? The word "information" is used to mean many things, and this vagueness and ambiguity is a source of confusion in both ordinary speech and science. However, information itself, as an undoubtedly important phenomenon in our world, receives little attention in science. Let's try to understand how information manifests itself in the physical world, how and to what extent it obeys the “material” laws of our world, how it participates in all kinds of interactions, how it is transformed and what forms it takes.

First of all, let's look at energy. Surprisingly, the term energy, despite its wide distribution, is defined in natural science very conditionally, namely through its properties, for example: energy is a measure of motion. Or energy is a measure of the force of transition of the movement of matter from one form to another to bring it to a state of rest. This is quite complicated and incomprehensible. Difficulties with basic definitions of elementary units are found everywhere and this is rather a philosophical and epistemological problem. For example, a similar pattern is observed in the foundations of mathematics, suffice it to recall Euclid's fifth postulate.

Similar to the situation with energy, we will define Information (with a capital “I”) based on its properties.

The easiest way to form an understanding of the term Information is to use linguistics. Letters convey additional information rather than a series of curves and straight lines representing it. Words convey additional information, much greater than the sum of the information contained in the letters. A sentence conveys more information than all the words alone. A paragraph conveys much more information than the individual sentences that make it up, and it is not so much the number of sentences that is important as their combination, composition and order. The text itself, context and subtext act as information flows, provide interaction with each other and generate additional information.

We see that Information tends to “increase” when interacting with Information of a “lower” level: letters-words-sentences-text, showing one of its properties: the capacity, complexity and richness of Information increases with the level of its structuring. In this regard, Information itself acts as a complex dynamic structure with its own set of interacting systems.

How does new information emerge? Is it born in the creative process? Or it moves from one carrier to another, like energy from one form to another.

To clarify the laws and properties of Information, let us return to its understanding based on language. It is known that language is a means of communication adapted for manipulating Information, therefore linguistic analysis demonstrates the basic properties of Information as a whole. For example, one of the properties is the continuity of the flow of Information. Text as a carrier of information fits into the concept of a continuous flow and therefore has typical flow properties. If water ensures the continuity of its flow by corresponding triplets and singlets (certain forms of molecules clinging to each other), then linguistics has its own mechanisms for ensuring the continuity of the text at various levels. For example, in the famous poem “The House That Jack Built,” the continuity of flow is maintained by a chain structure.

This is the house that Jack built.

This is the malt that lay in the house that Jack built.

This is the rat that ate the malt

That lay in the house that Jack built.

This is the cat that killed the rat

That ate the malt that lay in the house that Jack built.

The property of continuity of the flow of Information allows Information to be in an active state. In this state, Information appears when we think, listen to speech, use vision or other senses.

To understand the meaning of the concept of continuity of Information flow, you can use the analogy with Calculation. While something is being calculated, it is a "continuous" process; As soon as the calculation is completed and the result is obtained, the process stops.

Information has some similarities with energy; it is characterized by a continuous presence in an active state, like kinetic energy, and the ability to “stay” in an inactive phase (save), like potential energy. But unlike the

Law of Conservation of Energy, information can be created, degraded and lost.

The ability of Information to be preserved presupposes the presence of a Storage medium and defines new key terms necessary for its existence: Memory and Observer. Memory is a program, a set of instructions, directions, relationships with the help of which information can be reproduced from a Storage.

Examples of Storage media can be books, musical works of art, paintings, sculptures, flash drives, electromagnetic radiation, fields, and any objects in general.

The Observer is one of the key aspects of information functioning. The Observer, using Memory, reads the program, with its help reproduces (gives birth) Information, transferring it to an active state, interacts with it and stores it on a Storage. Observers can be any systems and objects of our world that participate in interactions.

Information and its “images” stored on Storage are proposed to be considered as different concepts. For example, we identify kinetic and potential energy as two forms, they transform into each other and equally participate in the laws of conservation, but accurate restoration of Information is not always possible, and this indicates the non-equivalence of these concepts. “A thought, once expressed, is a lie.” In the world of science, there are theorems on this subject about the impossibility of “full” cloning.

Information can be saved by copying it to a storage medium, but when leaving the active state, the information disappears.

Examples. You store socks in a closet drawer. If you took the right sock out of the box, it can actually give you information about its left partner, which was left in the box. The right sock does not mean that the left sock is in the box, but you, using the data and correlations received through the visual channel, translate the Information into an active form, causing it to interact with the active Information from the neural network in the brain. There the “relevant” guess about the left sock in the drawer is born.

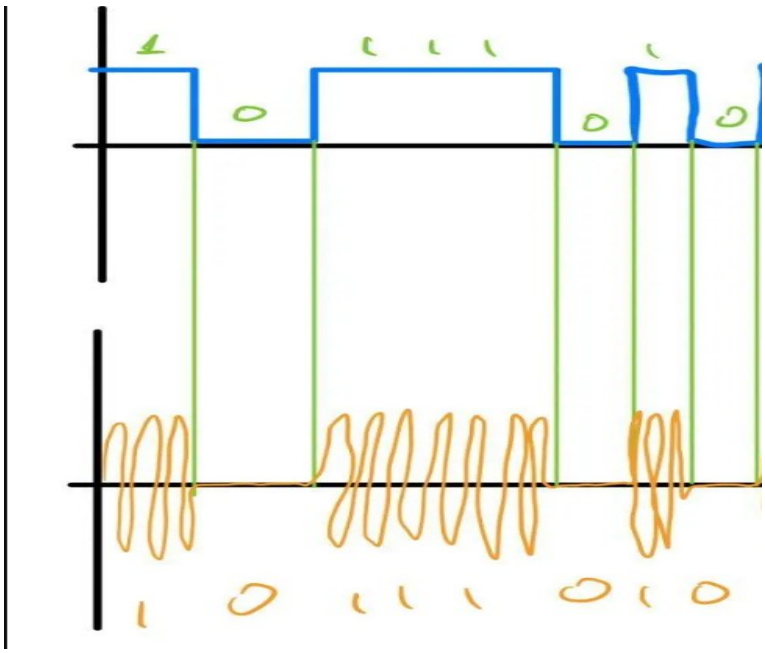
The term “correlation” can be conventionally understood as a “code” or correspondence, with the help of which information about various interactions can be restored.

"Relevant" information means information:

1. what we have learned about this system as a result of past interactions

2. allowing us to predict what we will get as a result of future interactions with this system.

The figure below shows an example of the transmission of symbol data and the “birth” of Information from a modulated electromagnetic wave.



Taking into account the reference sets (positive meanders of the reference wave (blue color) and ASCII letter codes), we obtain the symbol “]”.

In living nature, Information is born as a result of the functioning of neural networks. In the physical world around us, it appears during various interactions of systems, energies or fields. For example, in the quantum world as a result of the interaction of covariant quantum fields.

Another feature of information is its redundancy. Redundancy further ensures continuity of information flow. For example, any text is redundant. If you apply an archiver (packer) to any text, you will get a file compressed by 70-90%. Reverse unzipping restores the original text 100%, which proves its redundancy. In other words, language redundancy is an obvious statistical pattern in the appearance of letters, pairs of consecutive letters, triplets, etc. (see Markov chains). On the other hand, redundancy is a manifestation of the entropy of a given text. Entropy is blurriness, uncertainty, white noise in Information.

So: Information is stored as Memory of interactions on material or energy media. Information emerges through various interactions. Information in an active state exists only in a continuous flow. Information has the properties of redundancy and multi-layer structure. When leaving the stream or when the stream disappears, the information disappears. Information contains entropy. Information is transmitted (distributed, moved) by copying. This is the main way of moving Information in the physical world.

So: Information is stored as Memory of interactions on material or energy media. Information arises from various interactions. Information in an active state exists only in a continuous flow. Information has the properties of redundancy and multilayer structure. When you leave the flow or when the flow disappears, the information disappears. There is redundancy of information. Information is transmitted (distributed, moved) by copying. This is the main way of moving Information in the physical world.

Let's take a closer look at the “movement” of Information, again using linguistics as an example. Let's take the word "fox". Does this word contain information? At first glance, the answer seems obvious - yes. After all, by reading this word, we receive “reliable” Information. But how do we get it? The word is represented by a set of symbols, more precisely, pieces of curved lines. They have patterns, forms, order - that is, a set of certain relationships, in other words, codes. We read the word. Reading is the sequential transmission of various relationships through different Observers and the sequential storage of various Information on appropriate media. Conventionally, this sequence of carriers is as follows: a light wave reflected from paper with codes in the form of modulations of a certain frequency - retina - fundus of the eye - cones - nerve endings - brain cells - neural network of the brain. During the movement of the word “fox”, each Observer in his own way restores (gives birth to) Information from mutual correlations with the previous Observer, and writes it “in his own words,” that is, in his own code. . And only at the last stage we (Observers) create information in the form of a thought-form - a fox.

So was there Information in the word “fox”? Of course, the word “fox” was written by a certain Observer and he intended to convey information about the fox with this word.

But he wrote a code, a correlation (program), with the help of which another person can “restore” the Information. And what is written is a set of instructions. So why the instructions, why what is written is not the Information itself.

Suppose the wind accidentally scattered sand like a shape similar to the word “fox”... so what? Information suddenly appeared out of nowhere? Did the wind bring this information? Does he know the fox from somewhere??

Or the word fox is written in Morse code. There is nothing from the fox there, but the Observer, knowing the code, can easily restore information about the fox. Information exists only in the continuous flow of the Observer. Only an image of Information in the form of various ratios can exist on the media.

We are used to using the word information. This is a collective image, it is vague, ambiguous, and not strictly defined. But that is why it is convenient

to use it, giving it different meanings in different cases. It is hardly advisable to identify this word with the introduced concept of Information. But sometimes the meanings of these terms overlap and even coincide.

In connection with the above, we can conclude that there is only an indirect connection between active Information and Memory on the media. In general, we can say that Information is a description of interactions between systems.

The scientific concept of information and information model was first introduced by Claude Shannon. Having difficulty defining information precisely, Shannon introduced the concept of entropy and defined information as a decrease in entropy.

In his definition, information as the value of inverse entropy (there is a minus sign) was narrowed down to a set of alternatives N and was defined by the formula:

$$I = -\sum_{i=1}^{N} p_i \log_2 p_i$$

where I is the amount of information (on average per alternative), and p_i is the probability of the appearance of the corresponding alternative. The base two logarithm is chosen as the minimum number of alternatives, that is a choice between two possibilities, and defines a bit of information. If the alternatives are equal, the formula will look to view:

$$I = -\sum_{i=1}^{N} \frac{1}{N} \log_2 \frac{1}{N} = \log_2 N$$

That is, information according to Shannon is binary entropy taken with the opposite sign. But since entropy is still associated with the property of redundancy, it is not possible to use these formulas in the interaction of complex systems. In the Universe, entropy changes not according to a logarithmic, but according to an exponential law,

$$\frac{dS}{dt} = 4\kappa \left(\exp\left(\frac{S_\infty - S}{C} \right) - 1 \right)$$

which contradicts Shannon's theory.

Despite the one-sidedness and narrow focus of Shannon's theory of signal transmission over communication lines, some ideas were successfully implemented by von Neumann in the first computer architecture. To solve problems, he “restored” the active state of Information, creating a

continuous flow and functioning of active information, using a set of commands (programs) in the basic algorithm paradigm:

1. Receive a command from the address of the command counter.

2. Increment the command counter to move to the next command.

3. Run the command,

and «if» and «go to» operators, essentially creating a single-circuit analogue of a neural network.

The modern concept in physics (David Deutsch, Chiara Marletto - Constructor theory of information) is an attempt to postulate quantum information in terms of the possibility or impossibility of transformations of physical systems on the foundation of set theory (which is consistent with the ideas of Shannon and Boltzmann). The authors use similar ideas about correlation and Observers (Transformers and Agents) and Computation as active Information.

Information can significantly change the behavior of various systems, to one degree or another changing the usual laws of their interaction. A program written on controllers can control the behavior of space objects or robots. The human neural network, working with Information, creates new knowledge that can radically change the world around us.

There is no doubt that in the future there will be a transfer of all human knowledge into a global artificial intelligence system that will be able to manipulate and transform this information.

Summarizing the above, we can draw the following conclusions:

In the physical world, there is an information connection between interacting systems in the form of correlations that participate in the creation of the relevant Information.

The relevant information is final.

Information is transmitted by copying,

Information is transmitted in the form of codes.

Returning to the physical world, one can notice that during the interaction of any systems, Information is born in them. Ultimately, it is this Information that determines the order, functioning and, in general, all the laws of our Universe. Information in its essence and properties is “imperfect”, has redundancy, its component is entropy. Therefore, the laws of our world are not entirely perfect, and as a result of any interactions, entropy is born.

On the other hand, entropy, although in incomplete form, carries information about all interactions and is the Memory of the Universe.